thick well formed fibrous layer. My operation at that time consisted in the removal with a saw of a thin slice from each end, and then wiring the two refreshed bony surfaces together. Again no union took place. At the end of five months more, the general health of the patient being good, the site of fracture was again exposed, the loosened wires removed, the ends of the bones, which were bare and devoid of any appearance of reparative power, were thoroughly scraped, as was also the whole cavity among the soft parts in which they lay. The wound was not closed, but simply stuffed with a sterilized sponge dusted with iodoform, the whole covered with some absorbent material; a side splint completing the dressing. This second operation was more beneficial than the first. Abundant callus was thrown out about the ends of the fragments, and especially in the territory occupied by the sponge. The consolidation rapidly became so firm that the man was able to resume his work; but, nevertheless, full ossification was retarded, for at the end of three months slight lateral bending could still be impressed upon the bone at the seat of fracture.

In conclusion, I wish to say that, from the considerations which I have attempted to present in the preceding paragraphs, I am led to the conclusion that there is room to question the soundness of the teaching that imperfect immobilization is *often* the sole cause of non-union, or even the chief cause thereof. It seems to me rather that the weight of evidence is such as to justify the assignment to constitutional states, and to local conditions not within the control of the surgeon, a yet larger role in the etiology of pseudarthroses than is generally recognized.

LEWIS S. PILCHER.

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## A MODEL OPERATING THEATRE AND ITS FITTINGS.

There must be many readers of this journal who would value greatly the opportunity of traveling over the continent of Europe and studying carefully the construction and arrangements of the operating theatres which have, in recent years been constructed with a special view to the practice of the most rigorous antiseptic surgery. For various and different reasons most of us are unable to make this instructive and pleasant journey. But we can obtain some of its advantages by studying the description of the new operating theatre which has been built and fitted up under the direction of M. Maunoury, of Chartres, on his return from a visit, made with M. Kirmisson, to such well-known theatres as those in which operate Tripier of Lyons, Julliard and Reverdin of Geneva, Kocher of Berne, Socin of Bâle, Krönlein of Zurich, and Czerny of Heidelberg.

Lighting, cleaning, general arrangements, furniture, attendance, all differ in these new theatres from what is to be seen in older ones; because all are planned with a view to an end of which formerly no one had any idea, namely that of strict antisepsis. The ideal is to construct a theatre in which the attainment of this end shall be so facilitated that the surgeon may go about his operations with a mind free from anxiety, though not from responsibility on the point. It is satisfactory to think that it is not the most costly arrangements which bring us nearest to this ideal. M. Maunoury went from town to town with a fastidious eye, taking no individual as the only correct model, but culling an idea here and another there, and finally coming home to put the best of these notions into practical form. He was careful to learn from the evil as well as from the good he saw.

His new theatre was begun in September, 1886, and finished in May, 1887. Since June 6, he has been operating in it. Experience has brought to light various defects which he is careful to point out in his paper.

Chartres being a small hospital without a school, no rows of seats are required for spectators, but that does not materially affect the arrangement of the operating space proper. There is this to be borne in mind, however, that, while at some large institutions, e. g., that of Heidelberg, three separate theatres are provided, one for laparotomies, one for ordinary operations, and a third for septic cases, Chartres has to be content with one operating room only. This increases, if anything, the necessity for perfecting its details with a view to antisepsis.

The new theatre is about fifty yards from the main building of the hospital, a separation which has certain inconveniences. The only serious one is that the patients just operated on have to be carried back across the garden to the wards. For this purpose a warmed and covered stretcher or litter is used. On the other hand are to be placed the purity of air, the better lighting, the absence of nurses and servants, and the distance from such infectious cases as may be in the hospital.

But, for grave cases which specially require repose and warmth after operation there is a special room opening, not out of the operating theatre itself, but out of its ante-room or vestibule.

This vestibule is a small room with three doors, one opening into the garden, the second into the theatre and the third into the small room or ward already mentioned. The room door of the operating room is of iron. In the vestibule are kept the surgeons' aprons, the blankets, sheets, napkins, towels, etc.; an enamelled bucket for soiled linen, and also the furnace of the heating apparatus. By this arrangement the necessity is avoided for anyone to enter the theatre itself in the absence of the surgeon and his assistants, except the single reliable person who is entrusted with the cleansing of the theatre.

The theatre itself is a large apartment, nearly square, in which have been avoided all corners and grooves. Its angles are rounded and the window frames are even with the inner surface of the walls. None of the tables, pipes or other fittings approach to the wall nearer than an inch. The dimensions of the room are 4m 45 wide, 5m 45 long, and 3m 65 high. The wall on the side of entrance is the most elaborate. Upon this wall are the door of entry, the warming apparatus, a linen warmer and a water heater warmed with gas, a wash basin with hot- and cold-water taps, a Chamberland's filter with its receiver and lastly gas-fittings.

The opposite wall has a large window 2m 45 wide, by 2m 35 high and an injecteur on each side. In each of the side walls is also a window 1m 95 wide by 2m 35 high, besides numerous small tables. In the ceiling there is a sky-light 2m 90 wide by 2m 25 long.

All the materials used in this room can be washed freely with water. It contains no wood. Everything is iron, glass or Portland cement. The window frames are of iron and the ceiling as well as the walls are of bricks dressed with Portland. The whole is painted in oils with zinc white.

With regard to the question of dressing the walls the choice seems to be between plaster, stucco and an hydraulic cement. Plaster cannot resist damp. Stucco, though otherwise excellent, is dear and apt also to crack. For these reasons, M. Maunoury chose cement and hydraulic lime. Socin of Bâle has covered the walls of his theatre with a layer of hydraulic lime which can be painted over every year.

Although Maunoury asked to have a similar dressing applied to his walls, in some way or other they got covered with Portland cement. In about two months the paint began to come off in scales while yellowish drops transuded here and there. A new painting resulted no better.

Portland has also been employed for the floor and here it has given entire satisfaction. The greater part of the theatres which M. Maunoury has visited are paved either with Mosaic or with "Terrazzo," *i. e.*, a mixture of cement and crushed marble. Mosaic easily cracks; Portland makes the best floor of the three, provided only that it be laid on a sufficiently thick and strong bed of "Beton" which is a kind ot mortar.

The side windows extend from about o m 80 or o m 90 above the floor up to o m 50 from the ceiling. Experience has shown that it would have been better to have carried them right up to where the wall begins to arch off into the ceiling. The windows are divided perpendicularly into four, of which the two middle open outward. This prevents the blinds which are external from being lowered without going outside to do it. This disadvantage is, however, less than what would have resulted from the use of internal blinds or from making the windows open inward.

The roof of the building is high pitched and the window in it being narrower than that in the ceiling below, some of the light which should come through the latter is intercepted. A flat roof would have been preferable. Maunoury thinks that a double sky-light, or in other words a window in the ceiling and another in the roof essential for the following reasons: First, there would otherwise be an angular space difficult to clean; secondly, much heat would probably be lost; lastly, condensation of moisture on the glass would have been unavoidable and the water would have trickled down the walls or dropped into the room. The space between the two windows is always closed except a narrow chink beneath the border of the roof window, through which condensed steam can escape. Small as these fissures are, dust gets in and necessitates the occasional cleaning of the ceiling window. Without the roof window this dust would enter at all times and fall into the theatre itself, although the situation is a tranquil garden, large in size and almost in the country. What then would happen in a large town?

At first moisture used to collect on the ceiling window and drop into the room; but this was entirely prevented by placing in one of the panes a piece of perforated glass about eight inches by sixteen.

When the doors and windows are closed the only air which enters comes through the "calorifere" and the temperature can be rapidly raised to 20 or 25 degrees centigrade.

The water pipes are not buried in the masonry lest any leakage should occur, and they are kept at a slight distance from the wall so that they can easily be dusted or washed all around. A tap controls the main pipe as soon as it enters the building, and near it is a mouth piece covered by a cap which unscrews to permit the attachment of a long rubber tube, through which the whole theatre and its contents can be douched. The Chamberland's filter is "*à sept bougies.*" The water flows from it into a glass barrel which holds 50 litres. The upper opening of the glass barrel is closed with wadding pierced by the caoutchouc tube from the filter. The sponges, instruments and wounds are washed with this water only.

During the winter the filtered water remains perfectly clear, but during the hot weather, from July to September, a thin layer of green algæ develops. Chamberland's filter acts perfectly, and stops all germs, but the glass barrel is so large that it cannot be kept permanently sterile. It is as well not to exaggerate difficulties and dangers, and perhaps the water contains no pathogenic organisms, but M. Maunoury now boils all the filtered water he uses over a gas stove. The boiler heated by gas supplies hot water to the lavatory, it also encloses a small linen closet, and by means of a tap with tube attached serves to fill the reservoir of the operating table to be described presently. The wash basin is let into a marble table upon which lie glass receptacles for soap, brushes, etc. The basin itself consists of an iron receiver and a movable basin inside it.

The escape of the waste water which falls on the floor from the operating table or when the room is cleansed presents a difficult problem. Almost everywhere, even in the best theatres, the arrangement is a small grating in the floor leading by a covered drain to the street or even into the sewer. Whenever Maunoury has had the curiosity to raise this grating, he has found beneath it a collection of impurities in a narrow place difficult to clean. Moreover the syphon trap in the canal is not to be trusted. Besides, is not the water in the syphon itself a culture medium for germs? For the germs of the sewer outside which may thus infect the conduit and penetrate into the operating theatre itself. Following the advice of M. Tripier, Maunoury has made an open drain finishing at the wall with a copper tap, which when closed prevents a draught inward. Outside the room the drain is continued still open to the air as far as a trapped sink two yards off. Where the immediate exterior of the building is not private this exposure of bloody fluids would be objectionable. However the external drain could easily be kept clean anywhere. It has also been objected that in severe winters the drain would be frozen up. But it must be recollected that a great deal of the escaping water is warm. Also in winter it would be easy to place a temporary covering.

It is contemplated to attach a hot air chamber for sterilizing instruments and dressings to the gas stove. For artificial lighting a Cromartie's lamp is used, which does excellently for ordinary operations, but which would not do at all for a resection of intestine. Hence the electric light suitably arranged would be preferable.

Along the walls are placed a certain number of glass tables for the dressing and instrument cases, etc., in immediate use. They are 11 millim. thick and 30 or 40 centimetres wide. They rest on copper brackets which keep them 3 centimetres from the wall. Their collective length is more than 16 metres. The two irrigators or receptacles for the fluids used for douching wounds, consist each of a glass barrel containing 10 litres, fitted with rubber tube nearly 4 metres long.

They are charged, one with carbolic solution, the other with sublimate. They are stoppered with plugs of wadding and covered on the top with a loose cap of tin to keep the plug dry when the walls are douched.

The sponges are in four short necked bottles numbered 1, 2, 3, and 4 which are employed one after the other according to the practice of Professor Socin. When the sponges from No. 1 have been used they are washed and replaced in their bottle. No. 2 sponges have the next turn and so on until it comes round to No. 1 again. They are kept in carbolic solution.

There is nothing special to say about the bottles containing the various antiseptics in use, the boxes of dressings, the dishes, trays, etc. They lie on the glass tables.

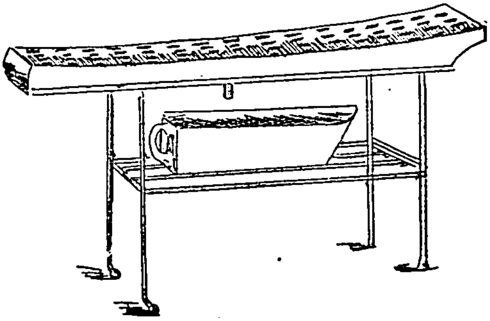

FIG. 1. OPERATING TABLE

The operation table, see Fig. 1, is easy to clean and cannot be impregnated with liquids. It is the table of Julliard as modified by Socin. The patient lies upon a sheet of zinc, sufficiently strong, and pierced with large holes to permit the escape of the douching water which in common tables soaks the patient from head to foot. This perforated sheet is placed 5 or 6 centimetres above a reservoir of the same area and capable of holding about 48 liters. When in use it is filled with warm water. Julliard placed this upon a wooden table.

Socin substituted iron, and put castors upon the legs. Mannoury thought the mobility too great, and had castors placed only on the fore legs. When the hind legs are lifted the whole table is easily wheeled. A receptacle beneath catches the water which flows through the table.

A second table, consisting of two frames of iron. placed one above the other and each supporting a glass tray, carries everything which the surgeon wishes to have at hand during the operation, such as instruments, sponges, catgut, lotions, etc.

From the clinique of M. Reverdin, of Geneva, M. Maunoury brought a very useful contrivance, shown in Fig. 2. It consists of two parts, a stool and a sheet of india rubber disposed in a special manner.

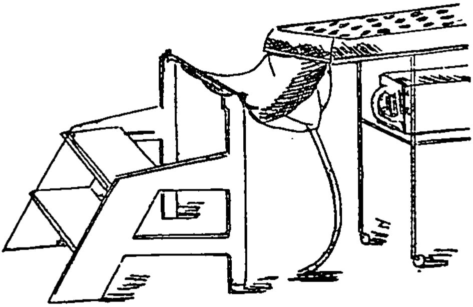

FIG. 2. REVERDIN'S STOOL.

"Reverdin's stool" is a kind of small steps, of which the higher one is divided lengthwise in such a way that it can be either turned up or turned down to make a seat for the surgeon. The two front legs are carried upwards nearly as high as the top of the operating table, and across them is is placed an iron bar, the extremities of which, a little raised and elbowed, are intended to sustain the feet of the patient, whilst the central part permits the surgeon to rest his fore-arms upon it, which gives a great precision to the movements of the hand.

M. Maunoury, having recently to do an operation for vesico-vaginal fistula which occupied more than an hour, did not at the end feel the least fatigue. The india rubber sheet forms a kind of funnel ending in a rubber tube which reaches to the ground. Besides being a protection to the surgeon it can be to a certain extent used by him as a table on which he can put down his speculum, etc., occasionally.

M. Maunoury finds the apron of india rubber with which the German surgeons cover themselves from head to foot, productive of great heat during a long operation and of a decided feeling of malaise at the end of it.

It was said at the commencement that at Chartres there is no school. But it would be easy to adapt such an operating room as has just been described to the requirements of a theatre for students. The wall of the room opposite the door of entrance would have to be removed and, instead would be built out room for rows of steps. It should be paved with Portland, like the floor of the room. The floor itself should be rigorously forbidden to persons coming from the rows of steps and the latter should be only accessible through a special door at the back. The steps and desks might themselves be of wood, but should stand on iron supports. Attempts to make satisfactory ones of iron or of iron combined with glass have not hitherto been very satisfactory.

The care of such an operating room and its proper cleansing require a person of intelligence and with a strong sense of duty, who will understand the importance of the rules he will have to strictly adhere to.

When an operation room is to be constructed on new principles, it is a point of the first importance that every detail of its construction should be carried out under the eye of the surgeon who is to use it. Otherwise the result will be a number of shams and some tremendous errors. Of course he will not actually direct the works himself. The architect has special problems to solve just as the surgeon has, and the latter has no competence to judge of the value of materials or to direct the workmen. What is necessary is a strict collaboration between the surgeon and the architect. Both considering before all things the end to be attained and holding quite secondary the means of attaining it. That is to say the surgeon, who alone understands fully this end should follow the architect step by step, and see that nothing is done which compromises the matter. Many details which to us are of the highest importance, may be regarded by the architect as trivial. If the surgeon is not on the spot, it may be afterwards next to impossible to correct the error. "That is to say" adds M. Maunoury, "if similar theatres to that which I have described are to be constructed in our great hospitals it is necessary, unless one desires a sterile labor, to avoid at all costs the submission of the project to those all-powerful commissions which are in a fair way to ruin us and render us ridiculous by covering Paris with monuments of which the facades cost millions but of which the interior is arranged without the least understanding of the ends to be attained." The "Hospitals Commission of Chartres," set the liberal and intelligent example of giving to M. Maunoury, its surgeon in chief, a free hand. He received at once the authority to direct the work and the responsibility for its proper construction. After receiving a preliminary estimate, it voted the sum necessary and left M. Maunoury to construct the theatre at his own risks and perils. The expenses were moderate. A detailed account is given in *Le Progrés Médical* for February, 1888, from which the whole of the information in this article is taken.

The total cost of building and furnishing amounted to 9,899 francs, *i. e.*, about £400. This includes 1,375 francs for furniture, the operating table cost 243 francs, the Chamberland's filter 77 francs, the iron instrument table with glass trays 67 francs, the Reverdin's stool 25 francs.

C. B. KEETLEY.